THE NATIONAL GEOGRAPHIC MAGAZINE

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THE NATIONAL GEOGRAPHIC MAGAZINE

RECENT FRENCH EXPLORATIONS IN AFRICA

BY DR. CHARLES RABOT, EDITOR OF "LA GÉOGRAPHIE"

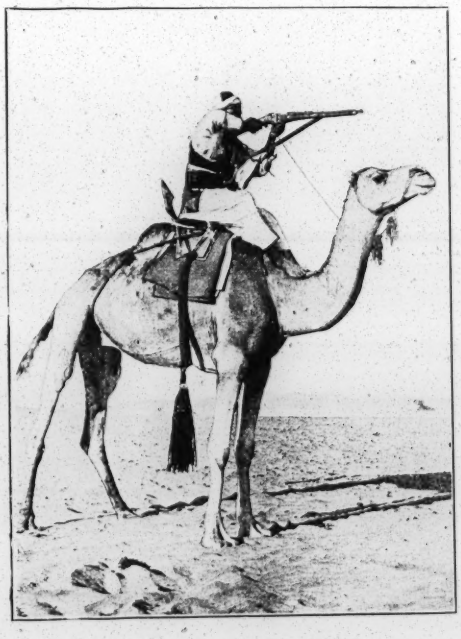
THE closing of the nineteenth century and the beginning of the twentieth are noted for important explorations in Africa by the French Government. In order to establish beyond dispute her sovereignty over the *hinterland* of her colonies, and to connect the scattered members of her colonial empire in Africa, France has been directing a number of military and civil expeditions whose results have greatly enriched our geographical knowledge of the northern half of the continent.

The regions in which the French have been specially active belong to three different zones: in the north, the Sahara; then passing southward, the Sudan or the higher basin of the Niger; and, thirdly, the tropical forest stretching from Guinea across the middle and lower basins of the Niger to the Kongo and beyond, the forest in the interior giving way to a land of dense brush.

The most famous of the French expeditions in Africa is that of Colonel Marchand. Its object was political—to prevent England from realizing her long-cherished plan of an African Empire stretching from Cape to Cairo. The Marchand expedition started from the Upper Ubangi for the east, while another expedition, commanded by Marquis de Bonchamp, then M. Michel, advancing from Abyssinia toward the west, was to meet him at the Nile. If this scheme failed politically, from a geographic point of view it was a magnificent success. The Marchand expedition, which, besides its chief, included seven officers, has obtained a very careful map of the entire region, in large part previously unknown, which stretches across Africa between the parallels of 5° and 10° north latitude. Lieutenant Commander Dyé, the astronomer of the party, determined the position of 75 points between Bangui, in the Kongo basin, and Jibuti, on the Red Sea. A large map on the scale of 1 : 3,000,000 will soon be published by the officers of the expedition, showing the country explored by them, but no account of this expedition has yet been published by any member of the party.

No less worthy of admiration than their cartographic achievements are the

heroic efforts of Marchand and his party in dragging to the very heart of Africa the boats and barges which they would need on the Nile. The Kongo and its tributaries and sub-tributaries, the Ubangi and the Mbomo, are cut by frequent rapids. To pass these barriers the boats were carried through the forests, sometimes dismantled, sometimes dragged just as they were. Troops of negroes, 1,800 in all, would take hold of the boats and push them along on tree trunks stretched across the yielding earth. Thus the party advanced to Brazzaville, the chief French post on the Kongo, situated at the head of navigation of the Ubangi, sometimes traveling in their boats on the river, but very often dragging and pushing them along instead. The distance they traveled thus was 2,187 miles. Between the basins of the Kongo-Ubangi, and the Nile, the water-divide consists of a slightly undulating plateau, in which the streams follow an uncertain course, so gentle is the slope of the divide. In order to carry the boats across this region, the soldiers of the expedition and the negroes opened a road one hundred miles long, over which they shoved the boats and barges. The party reached the basin of the Bahr-el-Ghazal, a tributary of the Nile, in 1897; the low water prevented them from continuing their march; it was not till 1898 that they gained Fashoda on the Nile. From Fashoda, Colonel Marchand continued his march eastward and through Lobat and the lofty Ethiopian plateau, reached Jibuti, on the Red sea, after a complete crossing of the continent.



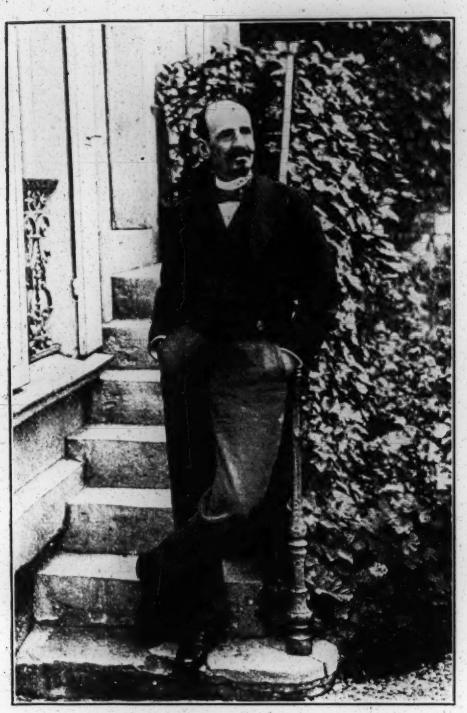
A Scout in the Desert

Photo by Flamand

In the country of Bahr-el-Ghazal, Commander Roulet, who was sent to join Marchand, gathered much interesting geographic information. According to this officer, Souet, Iba, and Ruwa, tributaries of the Bahr-el-Ghazal, are dry from December to May. From June to November they rise to a height of 15 to 24 feet, submerging the surrounding land and forming between the 8th and 9th parallels of north latitude an immense lake hundreds of miles in length.

The expedition that left Abyssinia before Marchand has brought back a survey of those upper tributaries whose union forms the Sobat. This survey was later completed by the Marchand party.

This expedition encountered terrible difficulties. While following the valley of the Baro toward the Nile in November, 1897, they fell into a country of morasses and tall grass, through which they toiled almost buried. One day ten hours of unceasing labor advanced them only three and one-half miles. The country was barren and gave no sustenance to the column. Worn with fever, with hunger, and fighting the morasses, deserted by the natives, the little French company were obliged to stop at the Sobat, at the junction of



M. Fernand Foureau

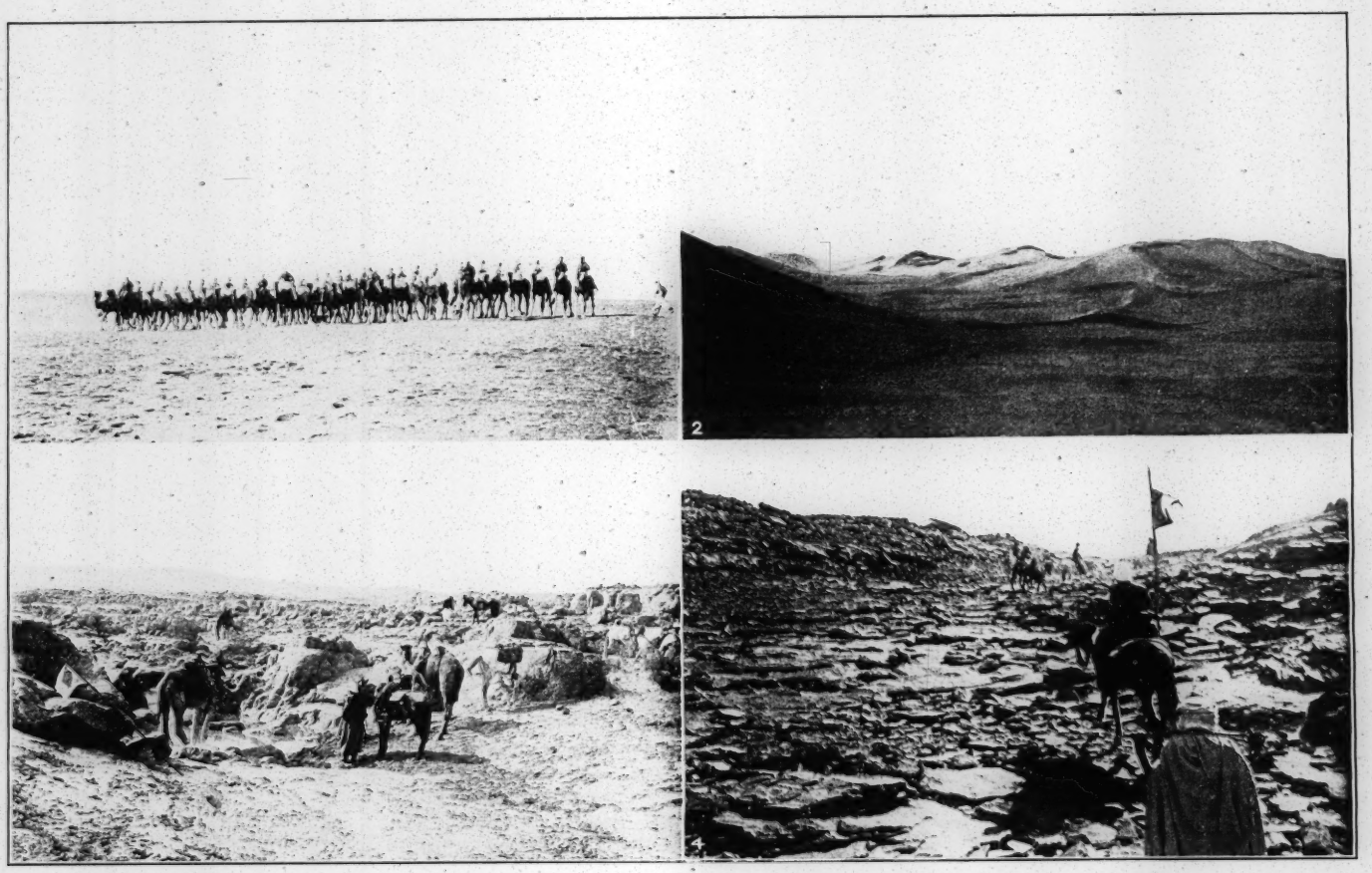
"If it can be done, I shall do it"

the Baro and Didessa. Finally, on June 22, 1898, two members of the party, MM. Potter and Faivre, who followed an army of King Menelik, reached the Nile, but were not able to remain there because they had insufficient supplies.

While these parties were working in the basin of the Nile, another no less important expedition, led by M. Fernand Foureau, left southern Algeria, intending to cross the Sahara from north to south in order to connect the French possessions of West Africa, the Niger, and the Tchad. All previous attempts to carry out this plan had been thwarted by the fierce Touaregs, those hardy bandits, who, fleeing on their swift camels, are the masters of the Sahara from Tripoli to Timbuktu and Tchad. The last French expedition organized to cross the desert, led by Colonel Flatters, had been massacred (1881). The Touaregs had not been chastised for their crime, and hence had become more audacious than ever.

The Foureau expedition was essentially scientific and peaceful in its aims, but the surest way of being peaceful is to be strong and able to compel respect by arms. The French Government therefore gave M. Foureau a military escort consisting of 285 Algerian soldiers and equipped with two Hotchkiss guns. The squadron included only 28 Europeans and was commanded by Captain Lamy. One thousand camels carried the provisions and supplies.

On the 23d of October, 1898, the expedition left Ouargla, marching directly southward for Air. The Sahara does not consist simply of stretches of sand; the zone of great dunes is succeeded by rocky plateaux and sharp, abrupt ravines. The crossing of this country presented fearful hardships. The first plateau, that of Tindesset (2,200 feet), required four days of effort and cost the lives of 40 camels. Afterward the climbing of the *massifs* of Tassili, Adrar, and Anahef caused the caravan much suffering. The divide between the waters of the Mediterranean and Atlantic passes along these ridges; at the point where Foureau crossed, it reaches a height of 4,533 feet; further to the west the mountains rise to 5,400 feet, and in Ahaggar the summits are as high as 6,000 feet, and in winter are sometimes covered with snow. The mountain relief is here much more prominent than has been supposed. Foureau's observations have shown that the water parting is 188 miles farther to the south than is given on the maps. In the country of Tassili the caravan experienced quite low temperatures, 13.8° Fahrenheit, January 3, 1899. Beyond the plateaux stretches a barren sea of rocks; no water, no trees, rare



1. Crossing the Sahara.
2. The Great Dunes
3. Resting in the Plateau of Tindesset
4. "The Great Dunes Are Succeeded by Rocky Plateaux"

Photos by Foureau

and thin patches of herbs for the camels. Under the relentless sun 140 camels perished in seven days. One hundred and more carcasses, seen in 48 hours of march, told Foureau, however, that the native caravans suffered no less in this fearful desert. February 24, 1899, the expedition reached Iferouane, the most northerly town of Air, having lost 400 camels, and with all that remained worn to the bone.

Foureau stayed three months at Iferouane to explore the oasis and to purchase new camels, so that he might continue his march. But the Touaregs stripped the country round about and furthermore bulldozed the natives from selling them anything. After a while they did not hesitate to attack the French caravan itself. They could not stay forever at Iferouane, so on May 26 one party of the expedition began the journey southward, carrying such baggage as they could on the camels that were still strong and leaving the remainder to the care of an escort. It was during their stay at Iferouane that they experienced the severest temperatures of the journey, 115.7° Fahrenheit, on May 19.

When they reached Aquellal, situated 31 miles south of Iferouane at the foot of a chain of mountains, the camels were sent back to bring up the baggage that had been left behind; but they could not carry everything, and much that had cost them such pain and suffering to drag so far had to be burned. Meanwhile, the Touaregs were becoming bolder and bolder, and attacked the expedition again. On June 25 they again started south across dry mountains torn with ravines. The extremely difficult and painful passage cost them more camels and mules; all the horses that survived were turned into beasts of burden, and the officers marched afoot. Thus they gained Aouderas and Agades. The natives of the country everywhere adopted the same tactics—they concealed their supplies, and only when repeatedly threatened gave them out with great niggardness.

At last they had crossed the Sahara; Tagama, covered with low brush, now stretches before them; and later Damergou, strewn with wide fields of millet and clumps of gigantic jujub trees. Under the shade of one of these trees more than one hundred men could rest with ease. On November 2 Foureau reached Zinder, the most eastern of the French posts in the Sudan, after having crossed the Sahara from north to south, from Algiers to the French possessions in East Africa.

Watering the Horses at Lake Tchad

Photo by Foureau

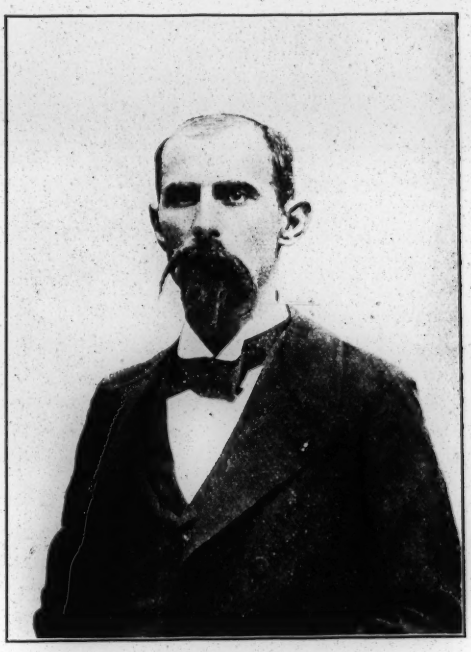
From Zinder the expedition proceeded east toward Tchad in order to join two other expeditions—one from the west, commanded by Lieutenant Joalland, and the other from the south, commanded by M. Gentil. The union of these three parties was to establish the French control over the region of Tchad and to free the country of Rabah, a Mohammedan conqueror, who for several years had been ravaging this part of Africa. Foureau marched along the north and east shores of Lake Tchad. During this journey he determined the contour of the lake; he reports that the level of the lake varies as much as 40 feet during the year.

Early in April the three French parties met on the Shari, the principal tributary to Lake Tchad. The scientific mission of Foureau was now ended. His work includes a survey of 3,655 miles, from Ouargla, in Algiers, to Bangui, on the Ubangi, in French Kongo, of which 1,218 miles had never before been traversed by a European. This survey is based on 510 astronomical positions. Foureau has also determined the boundary between the sedimentary formations of Northern Sahara and the crystalline *massifs* of Central Sahara, and collected, in addition, many botanical, zoölogical, ethnographical, and archæological specimens. In the Sahara archæology is represented by many figures sculptured in rocks and by very curious ancient tombs.

The two other expeditions, under Gentil and Joalland, have obtained equally important scientific results. During the years 1899 and 1900 M. Gentil, commissioner of the Territories of Tchad, and his colleagues, made surveys of 4,600 miles included between the sources of the Ubangi, the Niger, and Tchad. The first of these regions is quite well populated, there being about 15 inhabitants to the square mile. M. Gentil in a boat steamed over a large part of Lake Tchad, and found that this great lake is navigable at all seasons of the year. The peoples living here are extremely interesting. At Zinder feudal institutions exist such as were in France at the beginning of the Middle Ages. The people are thus ten centuries behind the world.

After their union, the three French troops, about 700 men strong, on April 22, 1900, attacked the army of the Rabah. He had 7,000 men, of whom 2,000 were armed with rapid-fire guns; but the little French company put them to complete rout. The country of Tchad was thus acquired.

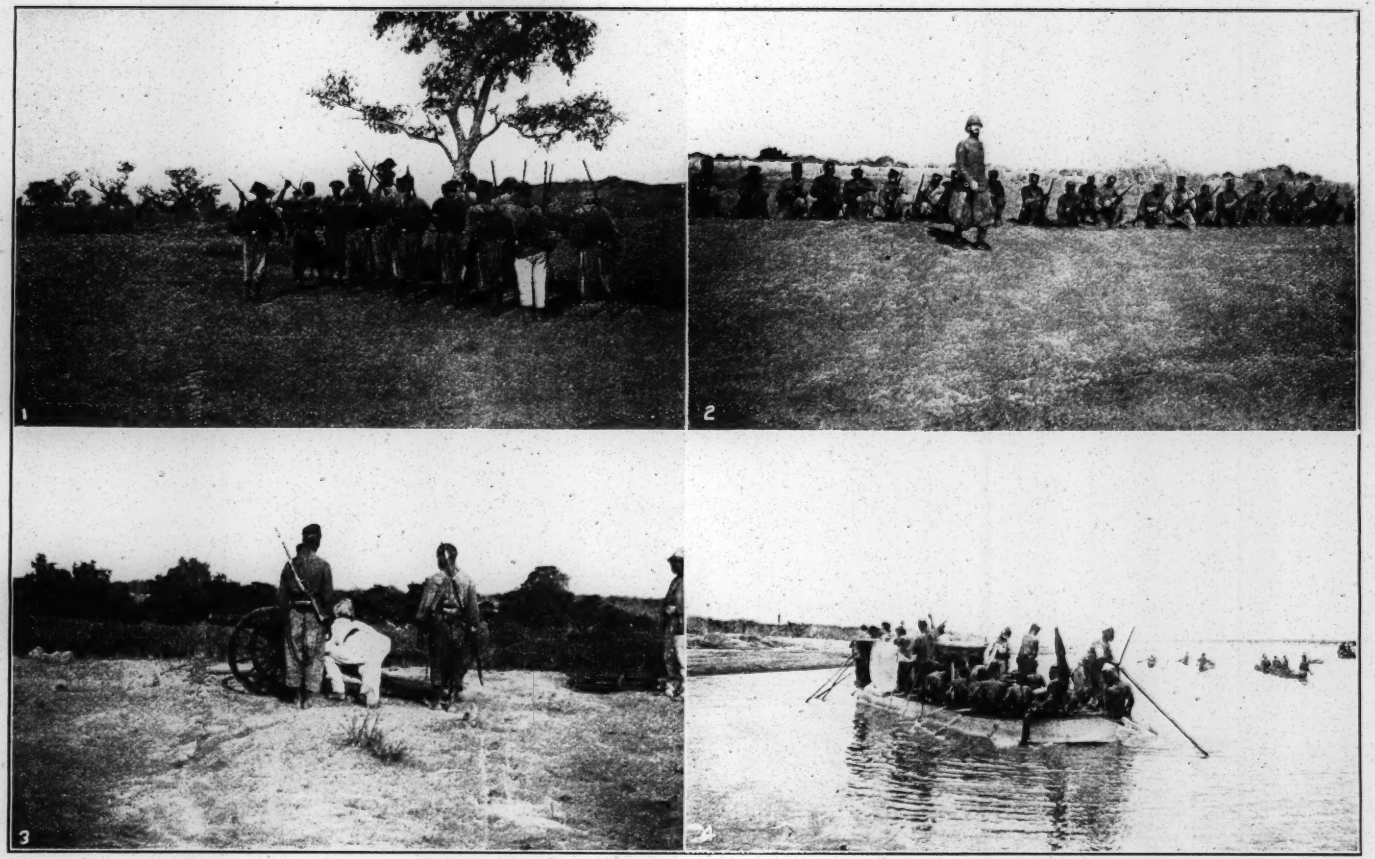
Besides these three principal expeditions of Marchand, Foureau, and Gentil, many other parties were exploring the different French Colonies of Africa. During December, 1899, to February, 1900, M. Flamand was exploring the oasis of Tibikelt, south of Algeria, where the phenomenon of eolian erosion is taking place. Flamand was attacked by the Arabs. The scientist immediately became a general, and with his 100 Arabs put his assailants to flight. By this victory France acquired the hitherto independent oases of Tidikelt, the possession of which will insure control of the tribes of the Sahara.



M. Gentil.

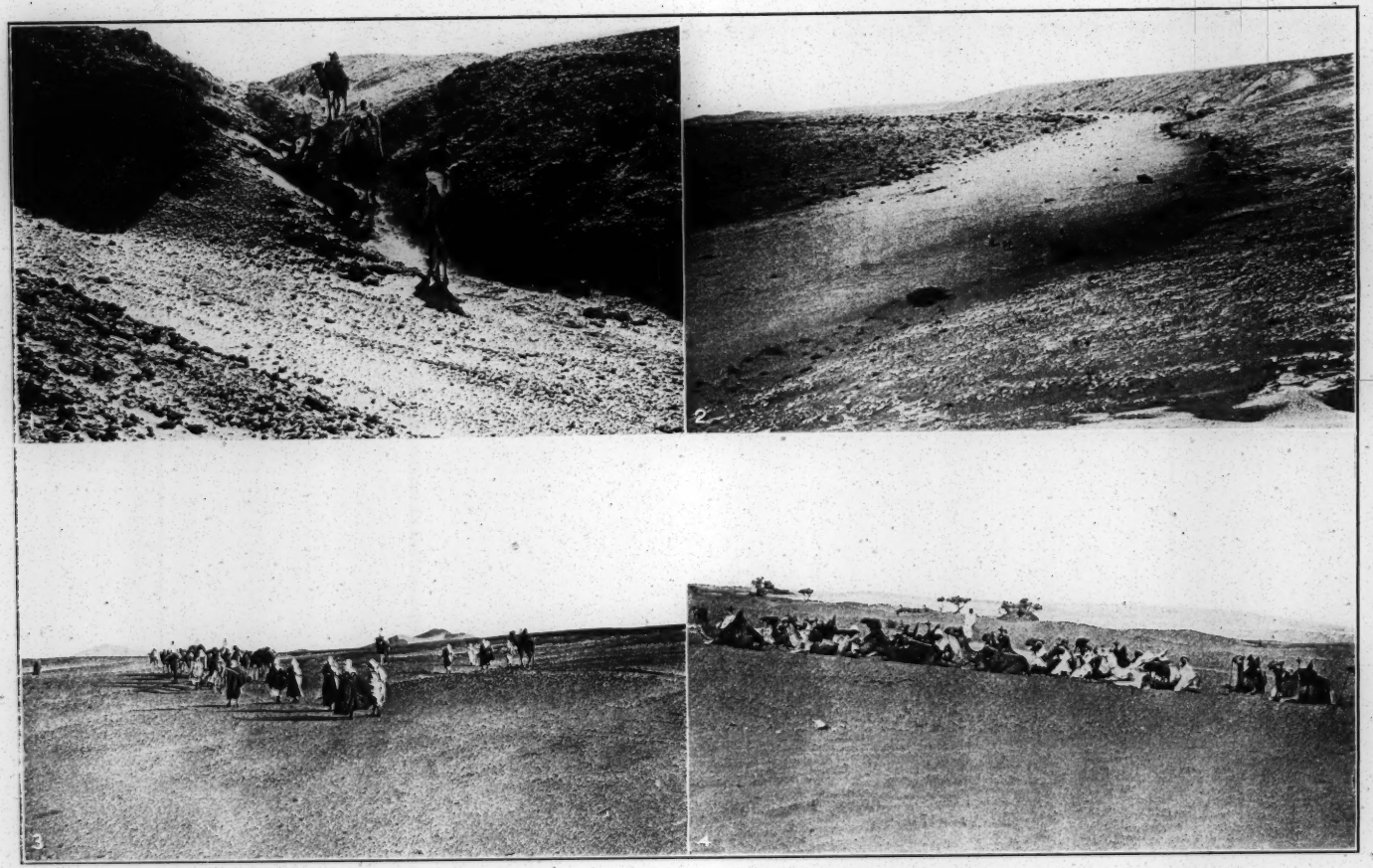
Less fortunate was the expedition of Blanchet in the region of Adrar, that part of the Sahara which is north of Senegal. The party was captured by the Moors, and remained in captivity for two months. When set free they were compelled to return.

In French West Africa three naturalists, Chevalier, Cligny, and Rambaud,



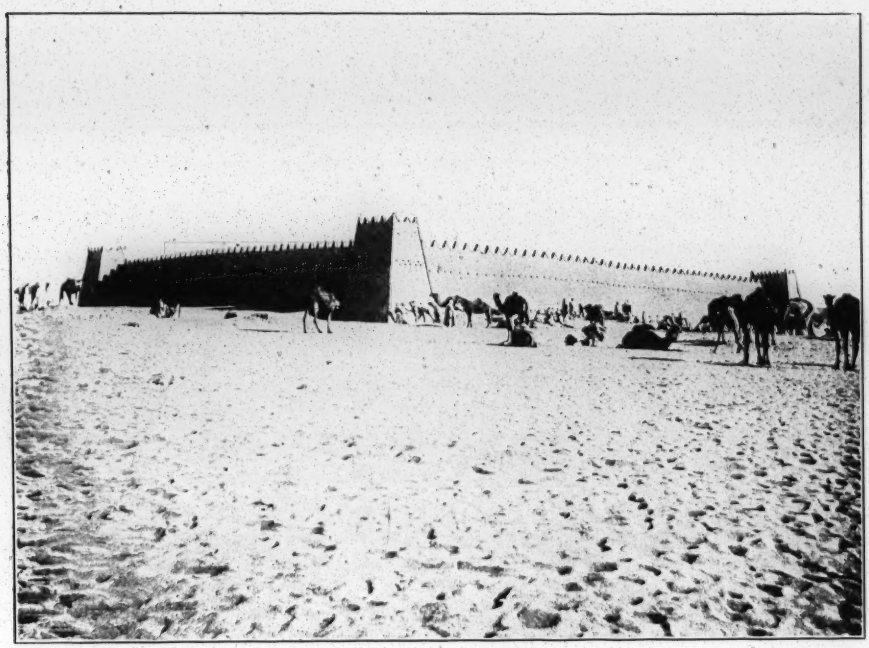
1. Senegal Musqueteers
2. In Battle Line
3. Checking an Atttack
4. On the Shari, near Busso

Photos by Gentil.



1. On the Road to Insala
2. Plateau of Insala
3. Marching Across the Desert—The Plateau of Tadmait
4. Ready for the Attack; the Men Crouch Behind the Camels

Photos by Flamand.



Castle of Insala

Photo by Flamand

completed a scientific examination undertaken in order to discover the material resources of the colonies. This region consists of three botanical zones: First, *la zône sahélienne*, characterized by some species of the Sahara and by rare underbrush growing on bare and sandy soil; second, *la zône soudanienne*, consisting in the main of plateaux of laterite and covered from June to November by dense prairies or meadows of tall grass and many kinds of herbs; third, *la zône guinéenne*, covered in the lower regions by dense and impenetrable forests and in the mountains by meadows or by underbrush, as in the zone of the Sudan. It is in this last zone, between 9° 30′ and 11° 30′ north latitude, that there grows in such abundance the *Landolphia heudelotii*, which furnishes all the caoutchouc exported from French West Africa. In 1900 the colony of French Guinea exported 1,464 tons of caoutchouc. This figure may be taken as the maximum production of the region.

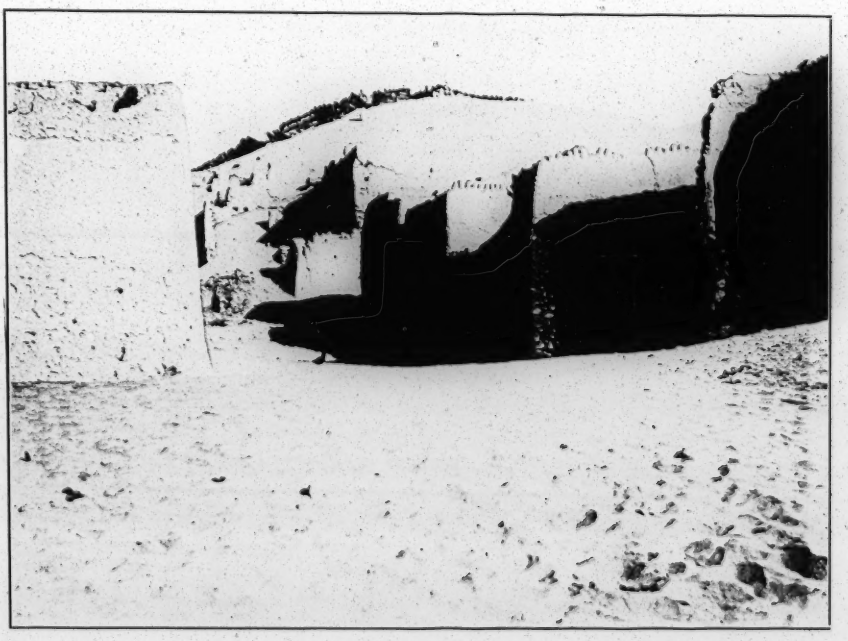
In 1899 and 1900 the hinterland of the Ivory Coast and French Guinea was explored by M. Hostains and Captain d'Ollone. Ascending the basin of Cavally, they gained Beyla, situated in the upper basin of the Niger, and thence proceeded to Konakry, the principal town of French Guinea. They had marched from the sea to within a few miles of Beyla through the dense tropical forest, often without a guide and directed only by the compass. In the midst of this luxuriant vegetation, which hid everything from them, they were attacked by the natives. For six days they fought without resting, tak-

ing by storm 44 towns. Against the multitudes of negroes they had only an escort of 20 Senegalese soldiers.

All the people inhabiting this part of the tropical forest are cannibals, but they are nevertheless much more civilized than their neighbors; they weave cloth; their villages are quite substantial; their roads are well planned, and they cultivate many vegetables. They hunt men in the Sudan and capture all they can; their captives are then butchered and eaten. But they do not lack meat for they have cattle, goats, and sheep. When they kill a man, each, according to his rank, receives a special portion; one has a right to the shoulder, another to the thigh, a third to arm and liver. MM. Hostains and d'Ollone were the first Europeans who had penetrated to the country of these cannibals; the region will soon be occupied by military French posts, who will try to put an end to these horrible practices. To help the Hostains-d'Ollone party Captain Woelffel, with a company of 100 Senegal soldiers, started from northern Sudan to meet them, but the hostility of the natives prevented a junction of the two parties. Captain Woelffel was compelled to fight for every mile of advance, and soon had lost two-thirds of his men in killed and wounded.

The maps made by the two expeditions have greatly changed our former idea of the hydrographic basins of this part of Africa; these maps show the existence of high mountain ranges rising to 9,000 feet between the Sassandra, the Cavally, and the Niger.

From all the French colonies on the west coast of Africa many expeditions, often directed by the officers of the colonial army, have set out to explore the hinterland. Each has brought back a survey of a river or a district. Thus

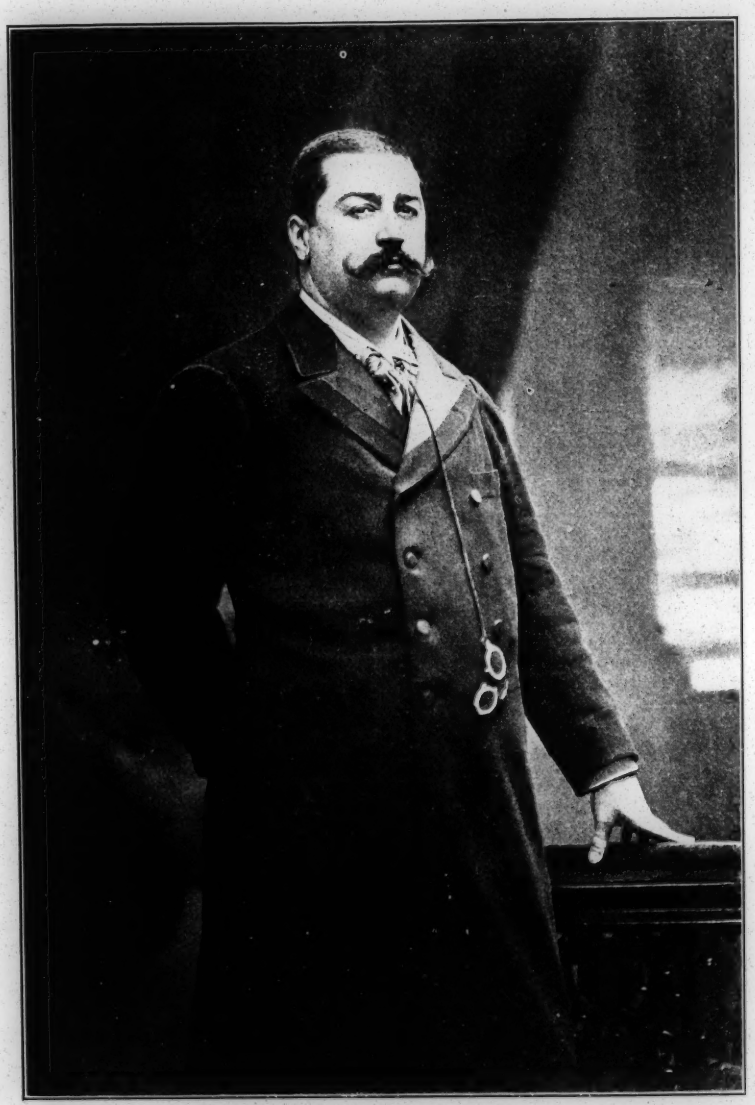


A Street in Insala

Photo by Flamand

A Village in Madagascar

Photo by Guillaume Grandidier



Prince Roland Bonaparte

Twice President of the "Société de Géographie" of Paris, Honorary Member of the National Geographic Society, etc., etc.

little by little the blank spots on the map are disappearing. In French Kongo, and notably to the north of this colony, these expeditions have been particularly frequent in order to define the lands granted to the great colonizing companies. Among these explorers we may mention the journeys of M. Lesieur and Captain Jobit in the basin of the Ogooé. In the basin of the Kongo the course of many tributaries to this great African river have been determined.

The work of defining the boundaries between the different European colonies on the west coast of Africa has resulted in many detailed surveys; these boundaries have been defined between Gold Coast and the Sudan, between Nigeria and Dahomey, between French Kongo and the Spanish piece at Rio Mouni. Finally the reconnaissance for a railway route from Konakry to the Niger and the observations of Captain Lenfant as to the value of the Senegal and of the Niger for water routes to the interior of the continent have served the interests of geography.

The most important topographic work as yet performed in Africa has been in Madagascar. General Gallieni, governor of the island since 1896, has adopted the methods used in the United States with such admirable results. He organized a survey of topographers and geodesists; in four years these officers have made charts of the great island based on a very precise triangulation. The scale is 1:1,000,000 and 1:500,000, and for central Madagascar 1:100,000. The maps, which are in colors, were engraved at Tananarivo, the capital, by a staff of natives. Scientific explorations have also been carried out in the south and southwest of the island by private individuals—MM. Bastard and Guillaume Grandidier—son of the famous explorer who is today President of the Société de Géographie of Paris.

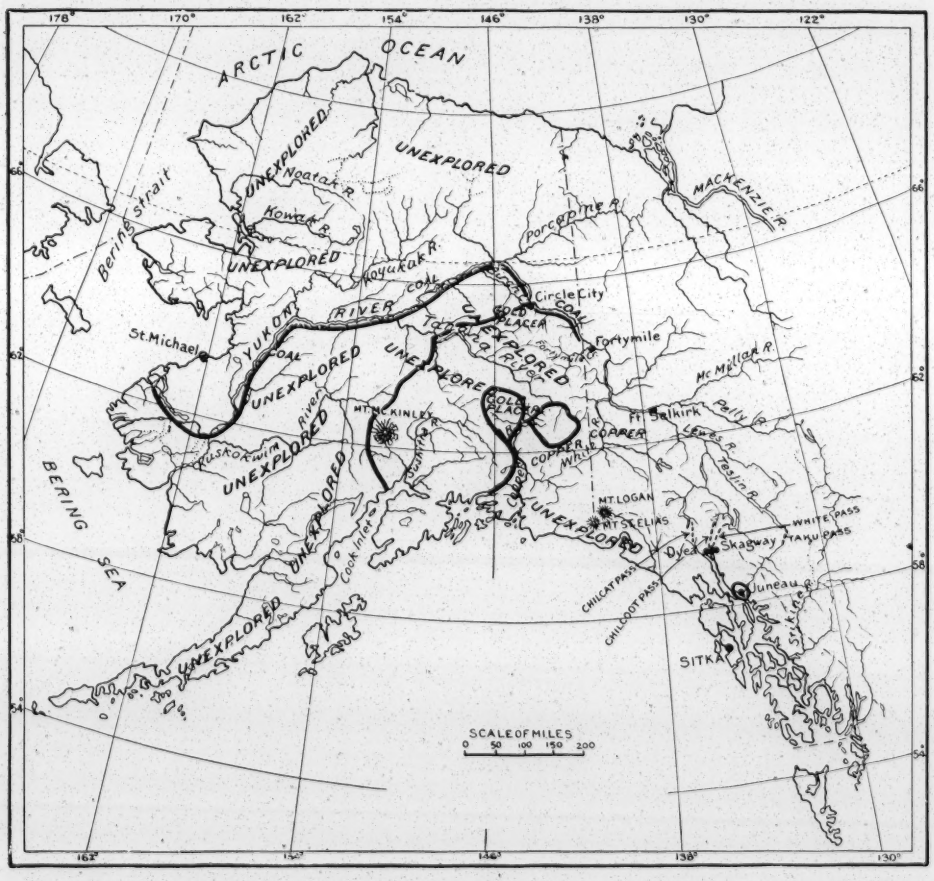
In conclusion I must mention some of the French explorations in Africa in territory that does not belong to France: In Egypt, the work of "La Mission Archéologique d'Egypt," directed by the eminent egyptologist, Maspero; in Tripoli, the journey of M. Mèhier de Mathuisieulx (1901). This last explorer reports that the country from Tunisia to the great Syrte and to the south of this portion of the coast is sterile and only one-twentieth part inhabited. Sooner or later, of course, Italy will gain possession of this territory.

West of Algeria, Morocco is equally coveted by several European powers. The country is still but little known, due to the Mohammedan fanaticism of its inhabitants, who massacre Europeans as soon as they get a chance. Quite recently several Frenchmen have explored Morocco, notably Lieutenant de Segonzac, who traversed the Great Atlas mountains and the valley of the Sus.

In the opposite quarter of Africa, in Abyssinia, the European powers are displaying great political and scientific zeal to gain the alliance of Menelik. In 1900, the celebrated French writer, M. Hugues Le Roux, achieved some interesting work in the upper valley of the Blue Nile, and has told his story in a book as thrilling as a romance, "Menelik et Nous." Starting from Addis Abeba, Hugues Le Roux proceeded to the east across the mountains that separate the upper basins of the Aouache and the Omo and the Didessa. All this country he describes as exceedingly picturesque, even more beautiful than Switzerland.

The story of all these explorations is told or summarized in "La Géographie," the monthly magazine of the "Société de Géographie" of Paris. The chairman of its editorial committee is Prince Roland Bonaparte, a great grandnephew of Napoleon I. This illustrious geographer has accomplished many important scientific excursions, especially in northern Europe, where he has made

some very noteworthy anthropological discoveries. He has been twice the president of the Société de Géographie. Prince Roland Bonaparte has visited the United States; probably when the International Geographical Congress meets in Washington in 1904, under the auspices of the National Geographic Society, he will again visit America to strengthen the ties of sympathy which bind French geographers and their colleagues in the United States.



Map Showing Unexplored Areas of Alaska. The heavy black lines indicate the proposed routes of the exploring parties from the Geological Survey in 1902

PROPOSED SURVEYS IN ALASKA IN 1902*

By Alfred H. Brooks, U. S. Geological Survey

SINCE 1898 the United States Geological Survey has been making systematic geologic and topographic surveys of Alaska. The annual appropriation by Congress for this work has been recently increased from twenty-five thousand to sixty thousand dollars in order to extend the investigation of Alaska's mineral resources. This increase has not been adequate to the needs of the work. The mineral interests have developed so rapidly in the past few years, and surveys in this distant province are so expensive, that it has been impossible with only sixty thousand dollars yearly to satisfy many of the urgent demands for work in various parts of the territory.

For three years past special attention has been given to the placer gold region of Nome, and the larger part of this area has been surveyed and investigated in some detail. The Koyukuk gold fields have also received considerable attention. In both of these fields, however, there is still much reconnaissance work to be done, besides the detailed work yet to be begun. Unfortunately, there is no money for the work to be carried on in these regions this coming season.

Southeastern Alaska is rapidly forging ahead in mineral production, and there are pressing demands on the Geological Survey for topographic and geologic surveys in this area.

During the season of 1901 it was impossible to continue the work of the previous year in the Copper River basin. in view of the importance of this area, it is deemed desirable to spend there a large part of this year's appropriation. The copper deposits of the Chitina River, a tributary of the Copper, have excited a great deal of interest among miners and capitalists. There have been many parties outfitted to prospect this region, and some preliminary development has been made. Prospecting has also been done in a second copper belt in the northern part of the Copper River and in the upper Tanana and White River basins. These two belts are to be the subject of special investigation during the coming season. The Chistochina gold fields, also included in the Copper River basin, have become important producers of placer gold. A survey of their entire area is contemplated. The surveys of the Copper River basin will also throw a good deal of light on the proposed railway route from Valdes to the Yukon River, and they will cover large areas which are believed to have value for stock raising and for cultivation.

The work in this region has been divided. One party will be in charge of Mr. F. C. Schrader, geologist, with Mr. D. C. Witherspoon, topographer, and the other will be in charge of Mr. T. C. Gerdine, topographer, with Mr. Walter C. Mendenhall, geologist. Mr. Schrader's party will map the upper Copper River basin and adjacent portions of the Tanana basin. They will connect the previous surveys of the Tanana River with those of the Copper and give special attention to the upper northern belt. Mr. Gerdine's party will map the Chistochina gold fields and will give attention to the southern copper belt, which was studied in 1900 by Messrs. Schrader and Spencer. The outfit and provisions for these two parties were shipped north in the latter part of February, and were transported across the coast range by a party led by Mr. D. C.

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Witherspoon. It is hoped that by the time the sledding breaks up all of the provisions and supplies will have been carried in as far as Copper Center, or possibly as far as the mouth of the Chistochina River. Both parties will then have their base of supplies comparatively accessible to the areas which they propose to map. The rest of the party will start inland from Valdes in the early part of April.

It is hoped that these two parties will give us a topographic map of the entire Copper River Basin and a geologic reconnaissance of the greater part of it; also that definite statements can be made, after the completion of the work, in regard to the identity of occurrence of copper in the two belts running north and south of the Wrangell group. Mr. Schrader's party will also gain important geographic data concerning the rugged mountain mass known as the Wrangell group, which has been but little explored.

In making plans for Alaskan surveys two objects are kept in view: the one to investigate areas of known importance as to their mineral resources; the other to extend the general exploration work over the entire territory, toward the end of obtaining complete geographic and geologic knowledge, and possibly of finding new mineral producing areas. The Copper River work is planned for investigating a region which is now producing mineral wealth.

Another party, which will explore the northern slope of the Alaskan Range, will have for its more special purpose a topographic and geologic reconnaissance. It is proposed that this party shall leave Seattle about May 15, going by steamer to Tyonok, on Cook Inlet. From that point it will go westward toward the head of the Beluga River until it strikes the base of the mountain range; then, turning northward, it will cross through the mountains by the pass at the head of Skwentna River, explored in 1898 by Mr. J. E. Spurr. From the Skwentna Pass the route will lie along the northern slope of the Alaskan Range. As far as possible the range itself will be penetrated and topographic and geologic data gathered. If the plan is carried out as contemplated, important information should be obtained concerning Mount McKinley, whose altitude, 20,464 feet, was determined by Mr. Robert Muldrow in 1898.

Mount McKinley, which is the highest mountain on the continent, lies in the heart of the Alaskan Range, and no one has yet reached its base. Proceeding in a northeasterly direction, the party will cross the Tanana near the mouth of the Cantwell. If when this point is reached the season should be far advanced, the party will be under the necessity of shooting the horses and proceeding down the Tanana by raft. From the mouth of the Tanana the return to the coast can be made by way of Dawson and the White Horse. Should time permit, however, the party will cross the Tanana at the mouth of the Cantwell, and, heading in a northeasterly direction, will cross the Tanana and Birch Creek gold districts and reach the Yukon at Circle City. This latter route would give a chance of investigating the important and little known gold fields on the lower Tanana. The party will be under the leadership of the writer, with Mr. D. L. Raeburn as topographer, and five camp hands. It is proposed to use twenty pack horses to carry the outfit and supplies.

As the accessible timber along the Yukon is being exhausted, the matter of fuel supply in the interior is of growing importance. Coal is known to exist in many localities, and has been mined at some profit. Much is of an inferior quality, but some fairly good lignite has been found. With a view to investigating this coal supply, a party will be sent down the Yukon during the coming season. Mr. Arthur J. Collier,

assistant geologist, will be in charge, and will be accompanied by two men. Mr. Collier will start at the international boundary and carefully study the Yukon section as far as the delta. He will make special investigation of such areas as are known to contain coal. He will also visit some of the placer camps accessible from the river which have not yet been investigated. This work is of particular importance from the standpoint of geologic correlation. Mr. Collier will have ample time to study the geologic relations in detail and to collect paleontologic data. It is believed that his work will throw considerable light on some of the broader stratigraphic problems of the territory.

Southeastern Alaska, embracing an area of about twenty thousand square miles, presents problems entirely different from those of the interior. The Coast and Geodetic Survey has completed the reconnaissance surveys of the coast line, but its detailed topographic work is limited to a few areas. As the mineral resources, consisting of gold, copper, silver, and nickel, occur in deposits which require large expenditures for underground mining, reduction works, etc., it is necessary, in this region, to carry on investigations in great detail, if they are to be of value to the mine-owners and prospectors. While the question of transportation is here much simplified because of the natural waterways, yet the dense timber and the heavy rainfall of the summer season make work in this region so difficult as to greatly increase the cost. Unless the appropriations are increased, it will take many years to map the most important mining districts alone. The Geological Survey, therefore, proposes to begin this work by mapping the Juneau mining district this year as a base for future detailed geologic studies. This topographic work will be in charge of Mr. W. J. Peters. The Juneau district is the most important in all Alaska, containing, as it does, the famous Treadwell mine.

We have a territory of nearly six hundred thousand square miles, and of this less than a sixth has been surveyed. These surveys have been chiefly of a reconnaissance character, and must be followed by mapping in greater detail. In view of the rapid development of the mineral resources, the immediate completion of the reconnaissance surveys and the initiation of the detailed surveys are a crying need. There would seem to be economy in such immediate furtherance of the important mining interests of Alaska.

OCEAN CURRENTS

By James Page, U. S. Hydrographic Office

EVERY method of investigation thus far employed, whether the drift of floating objects, the comparison of the temperature and specific gravity of specimens drawn from widely distant points, the distribution of animal organisms inhabiting different localities, all lend support to the belief that the vast mass of the surface water of the sea, and of the water some depth below the surface, even at a distance of thousands of miles from the continental shores, and hence far removed from local or tidal-current influence, is in motion ; and the continuity of this motion, in certain broad and well-de-

fined regions such as the tropics, cannot but impress us with the idea that it is in a general way cyclical—that is, that the same water, after the lapse of time, retraverses approximately the same path.

The source of the energy required to set and keep this vast mass in motion has been productive of endless discussion. The attractive force of the moon, the *vis inertiæ* or lag of the water itself, the difference in temperature and specific gravity of the equatorial and polar regions, the unequal distribution of atmospheric pressure—each in its turn has been proposed and strenuously advocated as the true and only cause of the ocean currents. To the seaman, however, the cause of the ocean currents has always been the winds, the motion of the waters of the sea taking its origin in the region where the latter attain their maximum constancy, viz., in the region of the trades.

The trade winds cover a belt on the earth's surface extending roughly over 50 degrees of latitude, from 30° N. to 20° S., including within this belt a greater water area than could be included in any other position. Throughout this wide zone the wind blows for 90 per cent of the time from some point in the eastern semicircle. In the southern hemisphere the trades are somewhat stronger and more constant than in the northern, owing probably to the freedom from interrupting land areas. Over the eastern half of the ocean they extend far higher in latitude than over the western. This is true of both hemispheres, the northern and the southern, the northeast trades in the Atlantic during the northern summer often extending far up on the coast of Spain, the southeast trades during the southern summer often extending beyond the Cape of Good Hope. Similar conditions hold for the Pacific. The southeast trades, too, blow well across the equator into the northern hemisphere.

The trade winds, however, are not continuous throughout the entire belt from north to south. Just north of the equator and confined entirely to the northern hemisphere, extending east and west, is an elongated triangular area, the base of the triangle, in length some 15° of latitude, resting in the case of the Atlantic Ocean on the coast of Africa, in the case of the Pacific on the coast of Central America and Mexico, throughout which the trades are absent, their place being taken during a large portion of the year by light, variable winds and calms, during the remainder of the year by winds whose prevailing direction is southwest—the so-called southwest monsoon of the African and American coast, most apparent during July, August, and September.

THE CHARACTER OF THE TRADE WINDS

Among those who have not sailed in them the impression is general that the trades blow day after day steadily in one direction and with a constant force. This is distinctly not the case. The trade winds are quite as susceptible to variation, and fortunately so, as the winds of higher latitudes. The one thing about them is that, not being subject to the large variations of barometric pressure which characterize higher latitudes, the wind rarely goes around the compass and, indeed, rarely gets out of the eastern semicircle. As an example of their constancy, let us consider the percentage of winds coming from each compass point for a certain region, for instance, the square bounded by the parallels 20°–25° N. and the meridians 50°–55° W., in the heart, therefore, of the northeast trades in the north Atlantic. The figures are for the month of June, and may be regarded as giving the number of hours in each hundred, or, approximately, in 4 days, that the wind may be expected to blow from the given point:

June.....	20°–25° N.....	N.	1
	50°–55° W.....	N. N. E.	3
		N. E.	17
		E. N. E.	24
		E.	33
		E. S. E.	8
		S. E.	10
		S. S. E.	4

Other squares show similar variations; some greater, some less.

THE IMPULSE COMMUNICATED BY THE WINDS TO THE SURFACE WATER

Let us now examine the effect of such a system of winds in impelling through surface friction the water with which they come in contact.

If through any cause a thin layer of liquid is set in motion in its own plane with a given velocity, the layer immediately below it, and with which it is in contact, does not remain at rest, but likewise receives an impulse. This second layer exercises a like impulse over the third, the third over the fourth, and so on, the velocity ultimately attained by each successive layer being proportional to its distance from the bottom layer, which is supposed to be at rest. In the case of sea water, the rapidity with which this velocity is propagated downward is very slight. It has been calculated, for instance, that a period of 239 years would elapse before a layer at a depth of 50 fathoms would attain a velocity equal to half that at the surface, and for a surface current of given velocity to transmit its proper proportion of that velocity to a depth of 2,000 fathoms would require an interval of 200,000 years, the surface current flowing steadily all this time. Such surface currents do not exist, nor do winds capable of producing them. The trades, as we have seen, fluctuate from day to day and, indeed, from hour to hour, and the surface currents fluctuate in obedience to them.

It has been stated, however, that the fluctuations of the trades rarely carry them out of the eastern semicircle, and that in point of fact 90 per cent of the winds that blow in the region of the trades do come from that semicircle. There is thus always a westerly component in the motion of the air, coupled with a component which is sometimes northerly, sometimes southerly. For each alteration in the direction of the wind there is a correspond ing alteration in the direction of the surface current, the new direction being the resultant of the old direction and the direction which would be imparted to it by the new wind acting alone. These, however, affect only the waters immediately at the surface. Thus, to cite a specific example, observations at the Adlergrund lightship, in the Baltic Sea, have shown that while the water at the surface responds almost immediately to a change in the direction of the wind, the water at the depth of 2½ fathoms does not feel its effects until an interval of 24 hours has elapsed. The steady westerly component is then the only one felt in the region of the trades at some little depth below the surface, and this is sufficient to impart to the entire body of water occupying the equatorial regions of the earth a westerly motion.

It is of some interest to note the velocity imparted to the surface water by winds of a given force. A comparison of a large number (658) of wind and current observations in the equatorial regions gave as the set imparted by a wind of force 4 on the Beaufort scale, corresponding to 20 miles per hour, a current velocity of 15 miles per day. The figures are taken from the "Meteorological Data for Nine 10°-squares of the North Atlantic Ocean," published by the Meteorological Committee of the Royal Society.

The system of surface currents produced by such a system of winds as the trades has been experimentally studied, using for this purpose a miniature ocean, the surface of the water being lightly

sprinkled with powder in order to render its motion visible. As soon as the artificial wind was brought into action, a drift was created, and the first tendency was for the water to flow from all sides into the rear of the drift. This gradually extended itself in a sheaf-like form, the marginal threads in the fields untouched or only occasionally touched by the air current leaving the main body, first branching out to the right and left, then reversing their motion, and finally again working round to the rear of the drift. The central portion of the drift followed a right-line course, in close agreement with the direction of the air current, until a perpendicular obstacle was interposed. Here the drift divided into two streams, each flowing with the same velocity, but having half the cross-section.

This experimental system of currents finds its counterpart in nature. Under the northeast trades in the north Atlantic and the southeast trades in the south Atlantic, we find a broad central drift directed toward the shores of America, the drift from the southeast trades extending well into the Northern Hemisphere, the two uniting some distance off Cape San Roque. To the right and to the left of each of these drifts the water fringes off, the direction of the motion is reversed, and the so-called compensating currents manifest themselves. Along the equatorial margin of the two main drifts, under the equatorial belt of calms, these compensating currents unite to form the counter-equatorial current, or Guinea current, reaching a maximum intensity during June, July, and August, the months of the southwest monsoon. On the polar margin they either return into the drift or are taken up by the general easterly drift of the higher latitudes.

In the equatorial region of the earth we thus have in either ocean three currents. In the north Atlantic the north equatorial current, due to the northeast trades; in the south Atlantic the south equatorial current, due to the southeast trades; between these two the counter-equatorial current, flowing at all times, but reaching a maximum intensity and covering a maximum area at the time of the southwest monsoon. These first two are westbound, carrying the water toward the shores of America; the third is eastbound, carrying toward the shores of Africa. They all suffer a slight displacement with the season, in harmony with the movements of the trades, which oscillate slightly in latitude with the movement of the sun in declination. Also, in harmony with the fact that the meteorological equator lies slightly to the north of the geographical equator, the south equatorial current extends at all seasons well over into the northern hemisphere. Corresponding again with the fact that the southeast trades exhibit greater constancy and strength than the northeast, the south equatorial current shows higher velocity than the north, the average for the latter amounting to but 13 miles in 24 hours, for the former to 27 miles in 24 hours.

Similar statements hold for the Pacific Ocean. But from this point let us limit ourselves to the Atlantic, the currents for which are not only better known, but also probably better developed, being confined to a less extensive area than the Pacific.

In the Atlantic Ocean, then, the two drifts unite some distance off Cape San Roque, the eastern extremity of South America. A portion of the water is diverted to the southward, forming the Brazilian current; the main body flows west-northwest along the coast of South America, some entering the Caribbean Sea by way of the passages separating the Windward Islands, the drift through these passages often attaining a velocity of 50 miles a day. The remainder passes to the northward of the islands, forming the Bahama current. In this

neighborhood a series of observations by Admiral Irminger, of the Danish navy, showed that the westerly drift of the water could still be detected at a depth of 900 meters.

A striking instance of the fluctuations of the surface currents with the winds is shown in the case of the straits separating the Greater Antilles, the Windward, and the Mona passage. From January to April, the months when the northeast trades are most northerly in direction and blow with maximum force, a strong southwesterly set is felt upon entering these passages. As the season advances and the trades weaken, at the same time becoming southeasterly, these currents diminish and change their direction to northwest.

Throughout the entire extent of the Caribbean Sea the drift is westerly, save that in those portions where resistance to the flow is offered, such as the southern coast of Cuba, return currents manifest themselves. Throughout the Yucatan passage the drift is northwesterly, but here again the influence of the return current is felt, notably under Cape San Antonio, the western extremity of Cuba, where southeasterly sets are frequent. In the Gulf of Mexico observations have thus far failed to reveal any decided set of the surface water.

THE GULF STREAM

Between the northern coast of Cuba and the Florida reefs starts the most celebrated of all ocean currents, the Gulf Stream. Discovered by Ponce de Leon in 1513, it has from that time been and still is the subject of scientific investigation.

In the Gulf Stream we have to deal with a current of a nature entirely distinct from those which we have thus far considered. These were all due to the direct action of the wind upon the water, producing a drift. The Gulf Stream is only indirectly due to this cause, being the overflow of the water heaped up by the trade-wind drift in the Caribbean Sea and the Gulf of Mexico. Throughout a considerable portion of its extent its direction, even at the surface, is independent of the wind or only slightly modified by it. The stream reaches its maximum strength at the point where it emerges from the Bemini Straits between the Bahama bank on the east and the coast of Florida on the west. The breadth of the actual current here between Fowey Rocks and Gun Cay Light is 38 miles, its average depth 239 fathoms, its average velocity 50 miles in 24 hours, although it rises at times to 100 miles. Farther north its breadth increases, and its velocity is correspondingly diminished. The western edge of the stream in its northward course along the coast of the United States follows closely the 100-fathom curve, although the axis of the stream, the line of greatest velocity, lies somewhat further seaward, its position varying, according to Pillsbury, with the declination of the moon, lying (at Jupiter) 8 miles farther off shore at time of low moon than at time of high. From Jupiter to Hatteras the axis runs at a distance varying from 11 to 20 miles outside the 100-fathom curve.

The color of the stream is a perceptibly deeper blue than that of the neighboring sea, this blueness forming one of the standard references of the nautical novelists. The depth of color is due to the high percentage or salt contained, as compared with the cold green water of higher latitudes, observation having shown that the more salt held in solution by sea water the more intensely blue is its color. Thus even in extratropical latitudes we sometimes observe water of a beautiful blue color, as for instance in the Mediterranean and in other nearly land-locked basins, where the influx of fresher water being more or less impeded, the percentage of

salt contained is raised by evaporation above the average.

Another important fact in connection with the stream is its almost tropical temperature, due to the fact that its high velocity enables it to reach the middle latitudes with very little loss of heat. Upon entering its limits, the temperature of the sea water frequently shows a rise of 10° and even 15°. It was this fact that gave to the stream in the later years of the eighteenth century and the earlier years of the nineteenth an importance in the minds of navigators that it no longer possesses. In those days the chronometer, invented by Harrison in 1765, was still an experiment. Instruments were crude and nautical tables often at fault. The result was that the determination of the longitude was largely a matter of guesswork, a vessel after a voyage from the channel to America often being out of her reckoning by degrees instead of by minutes. The idea, first suggested by Benjamin Franklin, that the master of a vessel, by observing the temperature of the surface water, could tell the moment of his entry into the Gulf Stream, and could hence fix his position to within a few miles, was hailed with delight. The method was published in 1799 by Jonathan Williams in a work lengthily entitled "Thermometrical Navigation, being a series of experiments and observations tending to prove that by ascertaining the relative heat of the sea water from time to time, the passage of a ship through the Gulf Stream, and from deep water into soundings, may be discovered in time to avoid danger." In this work he makes the patriotic comparison of the Gulf Stream to a streak of red, white, and blue painted upon the surface of the sea for the guidance of American navigators.

The discovery of the stream is also alleged to have exercised a curious effect upon the commerce of some of our southern cities. In those days, when the only known sailing route was by way of the trades, it was the custom for vessels making the voyage from Europe late in the year to winter and refit at Charleston or Savannah before attempting to reach the more northern ports of Boston and New York, the prevalence of the northwesterly gales along the coast during the winter season rendering the passage a trying one even to the larger ships and with the better navigation of the present time. The southern cities thus became to a certain degree half-way houses on the voyage, greatly to the benefit of their trade. With the aid of a thermometer, however, a vessel once making the stream was enabled to remain in its midst and to be thus borne along by the current until the desired northing was made, after which she headed up for port. Thus the necessity for making Charleston or Savannah was obviated, and the advantage which they had hitherto enjoyed as commercial centers was lost.

From Hatteras the course of the stream leaves the coast in an east-northeast direction. It ceases to exist as a stream current—that is, as a current which runs independently of the winds—shortly after crossing the 40th parallel, and even previous to that, the current observations in the square bounded by 35°–40° N., 65°–70° W. (off the coast from Hatteras to Sandy Hook), showing for the month of maximum frequency (September) but 32 per cent of the whole number of observations setting northeast—*i. e.*, only 7 per cent more than 25 per cent, which would be the number if there were no directive influence whatever. In this latitude it becomes part and parcel of the general easterly drift which characterizes the waters of the ocean north of 35° in a manner quite analogous to the westerly drift of the tropics and due to the same cause, namely, the prevailing winds. In this latitude, however, the latter show none of the persistency of the trades.

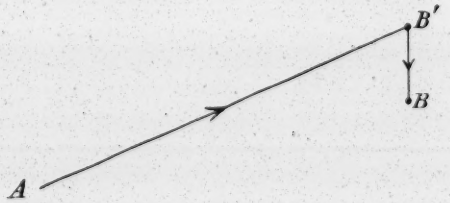
The winds of the North Atlantic Ocean, as also of the several other oceans—the South Atlantic, South Pacific, North Pacific, and the Indian—are governed mainly by the presence of an almost permanent area of high barometer covering the main body of the ocean, around which the winds constantly circulate, the circulation in the Northern Hemisphere being in the same direction as the hands of a clock, in the Southern Hemisphere in a contrary direction, or "with the sun" in either hemisphere, as it is expressed by sailors. In the North Atlantic the center of this area lies somewhat to the southwest of the Azores. On the southern slope of this barometric plateau the winds have an easterly direction—the northeast trades; on the northern slope, a westerly. These westerly winds, however, exhibit none of the constancy of the trades, being constantly interrupted by the wind systems proper to the alternate areas of high and low barometer which move across continent and ocean from west to east, and which form the governing feature of our own weather, the wind backing to the southeast with falling pressure, hauling to northwest with rising. Just as in the case of the trades, only to a much less extent; there is, however, a sufficient easterly component remaining to impart to the waters of the sea below the surface a distinct easterly motion, while on the surface itself there is apparently an utter lack of definite direction other than the fact that the direction of the current ordinarily agrees with the direction of the wind. How true this is may be gathered from a comparison of the observed winds and the observed currents for a given area; for instance, the 5° square included between the parallels 40°–45° N., 30°–35° W.—about in mid-ocean. The total number of wind observations recorded for the square was 8,898; of reliable current observations, 719. Dividing each of these up into quadrants and setting the current under that wind quadrant to which they are due, we have the following percentages:

	N. E.	S. E.	S. W.	N. W.
Winds	16	20	36	28
Currents	20	18	31	31

THE CONSTRUCTION OF CURRENT CHARTS

For our knowledge of the currents of the sea as tabulated in the current charts used by navigators—the movements of the waters as they actually take place—we are dependent upon ships' observations. When at sea the position of a vessel at noon of each day is determined by two independent methods. The first of these is known as the position by observation, and means, as its name implies, the position of the vessel as found by actual astronomical observation. The second is known as the position by dead reckoning, and is the position as found by reckoning up the vessel's progress from noon of the previous day, the compass giving the direction, the log the speed. In a majority of cases these two positions fail to agree. The astronomical position is then assumed to be correct, and the difference between them is set down as the current during the intervening 24 hours.

Thus let *A* be the position by observation at noon of a given day, *B'* the position by dead reckoning at noon of the following day—*i. e.*, the position de-



rived from a consideration of the course and distance during the intervening 24 hours. Suppose, however, that astronomical observations show that the

actual position of the vessel at noon the second day is at *B*. In this case *B'B* will be set down in the log as the current experienced during the intervening 24 hours. In case no astronomical observations can be obtained, as happens in fog or cloudy weather, the position by dead reckoning has to be adopted as the best obtainable, with the result that if such weather continues for several days in succession, as sometimes happens at certain seasons of the year, the true position of the vessel may differ considerably from the assumed position, which is frequently accompanied with disaster upon approaching shore. To lessen this danger these current charts have been constructed, giving the results of current observations in the past, and the master of a vessel, by reference to them, is able to profit by the experience of those who have sailed over the same waters in previous years, and to some extent correct his own dead reckoning.

The current charts of the various oceans published by the British Admiralty—the charts which are universally employed by navigators—are the result of many, many thousands of observations—in fact, of all the reliable current observations taken since 1830. A glance at these charts will make plain the difficulty which confronts the navigator when approaching a dangerous coast, such as that of Newfoundland or of France, and compelled to rely upon his dead reckoning.

For a knowledge of the motions of the water throughout longer periods of time we are forced to depend upon the drift of floating objects, derelicts, wreckage, floating bottles bearing messages, and the like. Two attempts recently made to study the currents of the sea by this method deserve mention. The first is an effort to obtain a knowledge of the currents in the Arctic Ocean. Stout oaken casks, each one numbered and bearing a message, have been distributed by the Philadelphia Geographical Society among the whalers bound for the Arctic by way of Bering Sea, where they winter in the vicinity of the mouth of the Mackenzie River. These casks are to be placed upon the ice as far eastward as circumstances permit, and the expectation is that they will enter the Atlantic either by Davis Strait or Barents Sea, be noticed by passing vessels, and picked up. A letter from Dr. Bryant, the president of the society, states that 35 out of the 50 casks have been already set out, and that in his opinion they may be looked for on the other side of the circumpolar area about a year from the spring of 1902.

The second project is the proposed investigation of the current in the neighborhood of Ushant and Finisterre by means of floating bottles. This has been undertaken by Lloyds, the great ship underwriting firm, and has probably been brought about by the number of vessels lately lost in that vicinity, owing to the fact that they were out in their reckoning. The bottles, which are of gutta-percha, are to be sealed and thrown into the sea by passing vessels, each one containing a label showing the date and the position at which it was cast adrift. They are then supposed to drift ashore and to be recovered. The expense involved is considerable. On the bottle it is stated that a reward of five francs will be paid for the return to any of His Majesty's consuls—an instance of liberality of expenditure in the acquisition of knowledge which is almost unprecedented.

GEOGRAPHIC NOTES

FRENCH EXPLORATIONS IN AFRICA

THE article in this number on "Recent French Explorations in Africa" is the first of a series to be published in this Magazine from time to time on the geographic work of the great governments of Europe. France, Germany, and Russia are actively exploring their respective spheres in Africa or in Asia in their search for what will help them in a political or material sense. Much has been done during the past several years, but the story of the work accomplished has been for the most part buried in scattered government reports. It will be the aim of this series of articles to present briefly the main results of this work.

The admirable article by Dr. Charles Rabot gives an authentic summary of the plucky and persistent efforts of the French explorers in North Africa. The inspiring motive of nearly all these expeditions has been political, to join the disconnected members of her African colonies into a united empire. That France will get out of these lands all they have and will cost her in blood and money seems to us Americans improbable; but from a scientific and geographic point of view, the results have been enormous. Great blanks in the map of the continent have been filled in and much knowledge of country and wild inhabitants gained.

Dr. Charles Rabot is well known as the enterprising editor of *La Géographie*, a French geographic journal, the organ of the Société de Géographie of Paris.

MOUNT FORAKER

ABOUT 20 miles from Mt. McKinley, the highest mountain in North America, there towers another mountain believed to be only a few hundred feet lower. It was first seen by Capt. Joseph S. Herron, U. S. Cavalry, in the summer of 1899, and by him estimated to be about 20,000 feet high, or 464 feet less than the measured height of Mt. McKinley. Captain Herron named the mountain Mt. Foraker, in honor of the distinguished Senator from Ohio who had nominated William McKinley at each convention that made him the Republican candidate for President. Herron reports that Mt. Foraker belongs to the same range as Mt. McKinley. He made a sketch of it, showing its relative position to Mt. McKinley and the range. The sketch is published in his report. For several months he was within sight of the two mountains, and was thus able to make a good study of them both.

Captain Herron had been charged by the War Department with the task of finding an all-American route to the Yukon from Cook Inlet to Fort Gibbon. He started from Cook Inlet June 9, 1899, and spent six months on the journey of some 500 miles. He proceeded slowly, surveying and mapping the country very carefully as he advanced. His report, handsomely illustrated from photographs, has recently been published by the War Department (Adjutant General's Office, Bulletin 31).

ROCKY MOUNTAIN COAL-FIELDS

ALONG the east base of the Rocky Mountains there extends a belt, 1,000 miles long, from the Canadian boundary through Montana, Wyoming, Colorado, and New Mexico, 60 per cent of which are coal-fields. A similar though smaller belt stretches along the west base of the range through Wyoming, Utah, Colorado, and New Mexico. Mr. L. S. Storrs, of the U. S. Geological Survey, has recently made a special investigation of this coal area and estimates that in the Rocky Moun-

tain region there are nearly 45,000 square miles of anthracite, bituminous, and lignitic-bituminous coal and 56,500 square miles of lignite. The results of the investigation are published in the twenty-second annual report of the Survey, part III, now in press.

Mr. Storrs believes the available coal of Colorado alone is thirty-four billion tons. The coals of Wyoming, lying largely in the plains region, are of a lower grade than the mountain coals of Colorado and Montana. The coal-fields of New Mexico have been explored only near the railroads, and those of Utah but little explored, so that no estimate can be formed of the coal resources of these two states. North Dakota's coal is lignitic and must be used very soon after leaving the mine, because it disintegrates so rapidly. There are no important coal mines in South Dakota. No careful exploration, however, has been made of the northwestern part of the state, where there is coal of more or less value. In Nevada coal of any value has been found only at one point, in the Eureka district. No coal is mined on a large scale in Idaho. In 1900, from the Rocky Mountain coal-fields 13,496,555 short tons were mined, worth about $17,400,000.

WORLD'S SUGAR PRODUCTION AND CONSUMPTION

A VERY timely bulletin has recently been issued by Hon. O. P. Austin giving the present statistical position of sugar. Fifty years ago about all the sugar consumed in Europe came from the tropics; from the West Indies, Louisiana, and the South American colonies in the Western Hemisphere, and from Java and parts of the East Indies in the Eastern Hemisphere. During the last half of the nineteenth century, however, the sugar-producing area of the world has been slowly shifting from the tropics northward to the temperate zone, due to the development of the beet-sugar industry. Practically all the countries of Europe are now engaged in the production of beet sugar. Spain, within the last five years, has developed a beet-sugar industry that supplies her home market and is now seeking for foreign outlets. Italy also within the last decade has made such progress in producing sugar that nearly two-thirds of the sugar used is produced within her borders. In 1900 Germany exported nearly one million tons of sugar—988,703; Austria-Hungary, 657,492 tons; France, 587,063 tons; Belgium, 300,757 tons, and Russia, 201,330 tons.

Two-thirds of the world's sugar supply is now produced from beets. Prior to 1871–'72 the world's production of beet sugar had never exceeded 1,000,000 tons for one year. In thirty years sugar produced from beets has quintupled, and for 1900 reached an estimated grand total of 5,510,000 tons. Meanwhile the sugar produced from cane has not quite doubled in quantity. In 1871–'72 the estimated production of cane sugar was 1,599,000 tons, while in 1900 it had reached a total of 2,904,000 tons.

The Coast and Geodetic Survey has just published a chart showing the lines of equal magnetic declination and of equal annual change in the United States for 1902. The chart is based on all known observations to date.

A topographic map of Philadelphia and vicinity has been recently issued by the Geological Survey. The map shows the city and suburbs on the south and west, and connects with another map, also just published by the Survey, showing the city of Chester and surrounding country to the Delaware line. The Survey had previously issued two sheets of the Norristown and Germantown suburbs, so that by mounting the

four sheets together an excellent map of the Philadelphia region may be obtained.

Dr. George Davidson has published an exhaustive treatise, with map, on "The Tracks and Landfalls of Bering and Chirikof on the Northwest Coast of America," from the point of their separation, in latitude 49° 10′, longitude 176° 40′ west, to their return to the same meridian—June–October, 1741.

Geographic Work in the Philippines.—Plans are being matured for extensive explorations in Mindanao, Mindoro, and Luzon. Of the two first-named islands practically nothing is known except the coastline. The work will be under the personal charge of Dr. David P. Barrows, chief of the Bureau of Non-Christian Tribes, P. I. Dr. Barrows is now in the United States, but on his return to Manila early in April will immediately enter the field. Mindoro is about twice the size of the state of Delaware, Mindanao is larger than the state of Indiana, and Luzon nearly as large as the state of New York.

Stretching from north to south across Luzon on either coast are parallel mountain ranges. The low country between the ranges is comparatively well known, but the mountainous region is unexplored, and little is known of the unchristianized tribes living there. The special object of the Bureau of Non-Christian Tribes is to study the natives of the islands who are not Christians and have not been under Christian influence.

The Wealth of Nations.—The London *Daily Mail* year book for 1902 estimates the wealth of the United States as nearly equal to the combined riches of France and Germany, as three times that of Russia, and about twenty-two billion dollars more than the wealth of Great Britain. In round numbers the wealth of the United States is figured at $81,650,000,000; of Great Britain, $59,030,000,000; France, $48,450,000,000; Germany, $40,260,000,000, and Russia, $32,125,000,000. The per cent of debt to wealth of these nations is estimated for the United States, 1.4 per cent; United Kingdom, 6 per cent; Germany, 8.1 per cent; Russia, 11.1 per cent; France, 12.8 per cent.

The original map made by George Washington in 1775 of the lands on the Great Kanawha River, West Virginia, granted to him by the British Government in 1763 for his services in the Braddock Expedition, is now in the possession of the Library of Congress. Mr. P. Lee Phillips, Chief of the Division of Maps and Charts, who recently obtained the map for the Library, has placed it on exhibition, where it can be seen by the many thousands daily visiting the Library. The map is about two by five feet, and is entirely in the handwriting of Washington. The margin is filled with notes, also in Washington's handwriting, describing the boundary marks set by Washington and different features of the tract.

"The Journal of School Geography," so successfully directed for many years by Richard E. Dodge, Professor of Geography in Columbia University, and "The American Bureau of Geography," of which Edward M. Lehnerts, Professor of Geography in the State Normal School of Minnesota, was the able editor, have joined forces, and will hereafter be issued as one publication. The title of the new magazine is "The Journal of Geography." It is planned "to meet the needs of all the teachers and students in geography." The journal, which will be issued ten times a year, is edited jointly by Professors Dodge and Lehnerts and J. Paul Goode, Professor of Geography in the University of Pennsylvania.

The First Crossing of Samar.—It has been repeatedly stated in the press reports recently that the first crossing of the island of Samar by Americans was made several weeks ago by Major Waller, of the Marine Corps. As a matter of fact, the island had been crossed several times previously by American officers and troops. For instance, the Military Information Division of the War Department has now in press a map showing several route sketches across Samar surveyed by Lieut. W. S. Martin from June to September, 1901. This map shows six distinct trails across the island. The scene of Waller's crossing was the southwestern corner of the island. A dense, impenetrable forest jungle covers large portions of the island. The jungle is so dense that even the natives are ignorant of what it hides.

The Peary Arctic Club has reëlected its present officers for the year 1902: Morris K. Jessup, president; H. W. Cannon, treasurer, and Herbert L. Bridgman, secretary. In July the club will send the *Windward* northward to take supplies to Mr. Peary and probably to bring him back in the fall. Mr. Peary is now leading his fourth consecutive campaign against the North Pole. In 1899 he reached Fort Conger, being the first to visit Conger since General Greely left it in 1883; in 1900 he rounded the Greenland Archipelago, perhaps the most important of all the important work he has done; in 1901 he again reached Fort Conger, but advanced only ten days beyond that point. This spring Fort Conger will again be his base and Cape Hecla his starting point for the Pole.

GEOGRAPHIC LITERATURE

The Mastery of the Pacific. By Archibald R. Colquhoun. With maps and illustrations. New York: The Macmillan Co., 1902.

Mr. Colquhoun has written many volumes, but probably none of them will command as widespread interest and attention as his latest book, "The Mastery of the Pacific." He has visited the Philippines, Australia, and New Zealand, and also lived for considerable time in China and Japan and in California, studying the life and peoples bordering the great ocean, for he has long believed that in the arena of the Pacific "will occur the great struggle of the twentieth century." The present volume aims successfully "to present a vivid impression of the various countries, their peoples, scenery, social and political life, and the parts they are destined to play in the great drama of the mastery of the Pacific."

One hundred and thirty pages are devoted to the United States in the Pacific, 130 pages to Great Britain in the Pacific, 80 to the Dutch, 36 to Japan, and 20 to Germany, France, Russia, and China. To Americans Mr. Colquhoun's observations in the Philippines are specially interesting.

The American plan "to fit the coming generation for its future" by education of the most advanced type Mr. Colquhoun pronounces "a beautiful theory and a beautiful scheme, but unfortunately it involves an entire subversion of the laws of nature." The Filipino is not simple and amenable, but a half-civilized, clever, irresponsible child, with warped ideas of right and wrong. "If unnaturally stimulated, he may grow up into a Frankenstein."

The great danger is that by a wholesale education a great mass of half-educated Filipinos will be developed, who

will be restless, discontented, and conceited, and turn against the government unless provided with offices. The Filipino loves the abstract—the theoretical side of learning; he will talk fluently about the principles of individual rights, but what these rights are in practice he does not know, and if they were given to him he would not recognize them.

There are many openings for capital in the Philippines, but very few for the individual without money. "This is no poor man's country; no place for the individual digger—the climate and cost of living preclude that—and it is to be hoped that the government will be able to prevent the influx of a large number of unemployed. Already mean whites are abundant and on the increase."

Everything considered, the Americans have begun well. Judge Taft "has won golden opinions from every side," and "is peculiarly the stamp of man to deal successfully with the Philippines."

Irrigation in the United States. By Frederick Haynes Newell, Hydraulic Engineer and Chief of the Division of Hydrography of the U. S. Geological Survey, etc. With many illustrations and maps. New York: T. Y. Crowell & Co., 1902. $2.00.

Mr. Newell, the chief of the Irrigation Division of the U. S. Geological Survey and the foremost authority on all matters relating to irrigation in this country, portrays in this book the conditions confronting man in the arid region, the character of the lands, the rainfall, and the available water supply. He describes the methods of stream measurement, the construction of irrigation works, the application of water to land, the occurrence of underground supplies of water, and the methods of raising it. Irrigation laws and the practice in different states are set forth clearly and simply. The work closes with descriptions of the states in the arid and semi-arid regions. It is a clear, simple, and full presentation of the subject addressed to the general public, to settlers and intending settlers in our arid regions rather than to technical experts.

One-third of the area of our country is dependent upon artificial watering for success in agriculture. With a wise application of the available water, many millions of people can find homes therein. Without water it is well-nigh valueless for home-making.

The theme of the book is the aphorism that in the arid region it is water, not land, that creates values. Of the arid region only about one per cent is now utilized through irrigation. It is estimated that there is sufficient water to reclaim ten times that amount, if properly applied. Land is abundant, water is scarce and precious. At present, nearly all the water that can be applied to land at small expense has been utilized. Future works of reclamation must be upon a large scale, and can best be done by the National Government. Under the plan, which is now before Congress, it is proposed that the Government construct the works and sell the water and lands to settlers at cost.

The increase in our arable area and consequent increase in our agricultural population, resulting from a complete utilization of our water supply, will benefit and strengthen our whole people, east as well as west, for the prosperity of one section increases the prosperity of all.

The illustrations merit special mention. The half-tones are admirably selected and well reproduced. The maps and diagrams are simple and yet wonderfully effective.

Scotland. Historic and Romantic. By Marie Hornor Lansdale. Illustrated. 2 vols. Philadelphia: Henry T. Coates & Co., 1902.

The best part of these volumes is the unusually fine illustrations. The text

is random, disconnected, and incomplete. The reader would infer from the description that the chief interest of the great castles and palaces is that the Earl So-and-So or the Bishop So-and-So was imprisoned, tortured, or beheaded in such-and-such a building. What they fought and died for is usually left to the reader to supply. Those who visit Scotland merely to see the historic fortresses and hear the grewsome tales which cling to each should take these volumes with them.

Wonderland, 1902. By Olin D. Wheeler. Illustrated. Published by Charles E. Fee, Northern Pacific Railway, St. Paul.

This handsome little book of 100 pages describes that part of the northwest which is tributary to the Northern Pacific Railway. The leading chapter tells the story of mining in Montana from the early sixties to the present; there are also chapters on the Northern Cheyenne Indians, the Yellowstone Park, and the Puget Sound country. Several hundred beautiful pictures are artistically arranged in the text. The publisher announces that the book will be sent to any address upon receipt of six cents, the cost of postage.

The Scenery of England. By the Right Honorable Lord Avebury (Sir John Lubbock). With illustrations. New York and London: The Macmillan Co. 1902. $2.50.

The author does not attempt to describe the scenery of England, but rather to explain wherein the rivers and hills, the moors and fens, and the great cliffs of the coast have had their origin. In other words, he does not directly tell what the country is, but how it has become what it is. The book is thus, in a certain sense, a geologic history of England. It is written in Lord Avebury's terse and pointed style, and is an exceedingly valuable work. Some of the chapter headings are "Geology," "The Coast," "The Origin of Mountains," "Volcanoes," "The History of a River," "Influence of Rocks upon Scenery," and "Downs, Wolds, Fens, Moors, and Commons." Rarely has any book of this character contained such graphic and real illustrations of the results and working of the different forces of nature.

Touring Alaska and the Yellowstone. By Charles M. Taylor, Jr. With illustrations. Philadelphia: George W. Jacobs and Company.

Mr. Taylor describes merely the ordinary tourist's trip by the Canadian Pacific road from the east to Seattle; thence by the steamer *Queen* to southeastern Alaska, and by rail from Skagway to White Horse, on the Yukon. The return journey was made by the Northern Pacific road, stopping a few days in the Yellowstone Park. The book is written in a bright, interesting manner, and the numerous illustrations are well selected and excellently reproduced.

China and the Allies. By A. Henry Savage Landor. Two volumes. Illustrated. New York: Charles Scribner's Sons, 1901.

The story of the Boxer uprisings and of the massacres and horrors of the months that followed are graphically told. It makes rather superficial reading, however, and beyond much excitement the reader gains little. The volumes are very handsomely illustrated.

Eastern Peru and Bolivia (H. H. Hill Publishing Company, Seattle) is the title of an interesting little book of 50 pages, giving some of the experiences in that country of William C. Ogle, a Yankee engineer who has prospected and worked gold mines all the way from Alaska to Bolivia.

NATIONAL GEOGRAPHIC SOCIETY

PROCEEDINGS

MEETINGS OF THE SOCIETY:

March 7, 1902.—President Graham Bell in the chair. The proceedings of the last meeting were read by Secretary Henry and approved.

"The Petroleum Resources of the United States" was the subject of an address by Dr. C. Willard Hayes and of the discussion following. Dr. Hayes briefly explained the composition of the hydrocarbons and outlined the several theories of the formation of petroleum—the organic theory, the inorganic hypothesis, and the theory that petroleum is formed by inorganic substances acting on organic substances. Petroleum in Pennsylvania is found in sandstone which looks so massive that at first sight it would seem to be solid; in Ohio it is found in the Trenton dolomites, and in Texas in porous and vesicular rocks. The age of the formations containing petroleum varies from Silurian in Ohio and Carboniferous in Pennsylvania to Neocene in California

There are no surface indications to indicate where petroleum exists. Certain characteristics of rocks, however, must be present. The rocks must be porous, they must have good cover (*i. e.*, must be overlain by an impervious stratum), and they must be flexed. The geologist can tell with certainty where oil will not be found; he can also tell where it may be found, but he cannot tell definitely where it will be found.

Dr. Hayes called attention to the peculiarity of the land at Beaumont, Texas. All wells drilled in the top of a sharp dome yield oil, but any holes drilled in the side of the dome yield no oil. As an instance of the great pressure of the oil at Beaumont, Dr. Hayes cited one well where, at a depth of 1,700 feet, the pressure was from 700 to 800 pounds to the square inch. He also called attention to the widespread use of oil as a fuel in some manufactories in the South, where it was found that one man could do the work of nearly fifty in the furnace-rooms.

The output of petroleum has more than doubled for the United States in the last 20 years. In 1880 the output was 26,286,123 barrels, and in 1900 it reached the enormous total of 63,362,704 barrels. Considerably more than half of the petroleum produced comes from the Appalachian field and about one-third from Ohio and Indiana.

Dr. Hayes said he wished especially to emphasize the fact that the supply of oil was not inexhaustible, but limited, and that unless the great waste at present was checked there would be an exhaustion of petroleum at no distant day. When gas was discovered the supply was thought to be unlimited, but already the natural-gas fields of the country have been practically exhausted. At least 1,000,000 barrels of oil have been wasted in one year at Beaumont. Such wasteful extravagance ought to be corrected if the oil is to last.

At the conclusion of Dr. Hayes' very interesting address President Bell called for remarks.

Prof. A. J. Henry mentioned the practice, common in certain parts of Ohio, Pennsylvania, and New York, of pumping abandoned wells at intervals, which is a quite profitable business when the price of oil is high. He also directed attention to the fact that presence of gas does not indicate that oil is to be found in the vicinity.

Mr. R. U. Goode inquired as to the relative price and value of oil found in the different fields.

Dr. Hayes remarked that the price depended upon what you could get for it. Beaumont oil sells for from 10 to 25 cents a barrel on the field; Pennsylvania is worth 90 cents a barrel, California 65 cents a barrel, and Texas 50 cents a barrel, or 75 cents if coal in the neighborhood is selling for $2.50 a ton.

Vice-President McGee called attention to the fact that young formations are richer and old formations poorer in hydrocarbons, instancing marsh gas as an illustration of contemporary origin of the substances. Dr. McGee also stated that the dome structure noted in Texas and elsewhere is not found in California, and inquired what was the mode of the accumulation of the oil in California.

Dr. Hayes, replying to the question as to whether any oil had been discovered in the West Indies or the Philippines, said that small quantities of a very pure oil had been found in Santa Clara, Cuba The peculiar fact of this oil was that it was associated with rock of igneous origin. So far as he was aware, there was no further developed field elsewhere in the West Indies. There was said to be some oil in the Philippines. The Appalachian oil field is the largest in the world, in extent greatly exceeding the Russian fields at Baku.

Dr. David P. Barrows mentioned the fact that in the Far East oil from Sumatra is extensively used, and there was also oil in Java.

Prof. C. C. Georgeson inquired as to the process of refining petroleum.

Dr. Hayes replied that he had not investigated the refining process sufficiently to consider himself competent to speak on that subject.

Mr. G. K. Gilbert believed that the speaker had given undue weight to the inorganic theory

as to the formation of petroleum, inasmuch as there was no observational basis for this theory. Inorganic materials, as far as we know, do not exist in combined form on the earth's crust. They may exist in combined form, but we know of no instance Mr. Gilbert also alluded to the growing custom of using oil for laying dust in road-beds of railways and in the streets in southern California.

The President referred to some oil fields in California which were beneath the surface of the water. The wells are drilled some distance from the shore. Dr. Bell also alluded to a neighbor of his in Cape Breton, Nova Scotia, who drilled an artesian well and obtained a small quantity of refined oil! At one time there was great excitement in Nova Scotia over the supposed existence of much petroleum there, but it turned out that there was no oil at all, except in some rare instances.

LECTURES:

March 12.—Vice-President McGee in the chair. Afternoon course.

Prof. E. F. Fenollosa, of the University of Tokio, gave an illustrated address on "Problems of the Pacific—Japan," which will be published later.

March 14.—President Graham Bell in the chair.

Dr. Charles H. Townsend, U. S. Fish Commission, gave an illustrated address on "Ocean Bottoms."

March 19.—President Graham Bell in the chair Afternoon course.

Mr. Henry Demarest Lloyd gave an address on "Problems of the Pacific—New Zealand," which will be published later.

ANNOUNCEMENTS

ANNUAL EXCURSION;

The Annual Excursion of the National Geographic Society will this year be to Gettysburg, Pennsylvania, on Saturday, May 17. By special arrangement with the Pennsylvania Railroad, the round trip ticket from Washington to Gettysburg will cost $2.25, provided 200 members and friends join the excursion. (The price of the regular round trip ticket is $5.60.) Luncheon persons may carry with them or buy at Gettysburg for a moderate sum. The Committee on the Annual Excursion, consisting of Col. Henry F. Blount, Mr. F. V. Coville, and Mr. Raymond A. Pearson, request that all members who intend to take part in the excursion, or who have friends desiring to join the party, should send their names, with the number of tickets they desire, to the Secretary of the Society as soon as possible. To secure the special train and the special fare, the Society must guarantee 200 tickets. Other details of the excursion, such as the time of departure of the train, etc., will be announced later. An interesting programme of addresses, to be given on the field of Gettysburg, is now being arranged by the Committee. It is earnestly hoped that many members of the Society resident outside of Washington may find it possible to join the excursion at either Gettysburg or Washington.

MEETINGS OF THE SOCIETY:

April 4.—Work of the Bureau of Forestry:

Development, Organization, and Policy of the Bureau of Forestry, Gifford Pinchot.

Division of Forest Management; Forest Working Plans; Scope of Work, O. W. Price.

The Arkansas Tract; A Specific Working Plan; Problems Involved, F. E. Olmsted.

Division of Forest Investigation; Scope of Work; Notable Investigations, Geo. B. Sudworth.

Section of Tree Planting; Scope of Work; Tree Planting, Wm. L. Hall.

April 18.—Results of recent Hydrographic Surveys:

Introductory Remarks, F. H. Newell.
Work in Arizona, Arthur P. Davis.
Work in Colorado, C. H. Fitch.
Work in Montana, Cyrus C. Babb.

LECTURES:

April 2.*—"Problems of the Pacific—The Commerce of the Great Ocean." Hon. O. P. Austin.

April 9.*—"Problems of the Pacific—The Great Ocean in World Growth." Vice-President McGee, LL. D.

April 11.—"Explorations in Antarctica." C. E. Borchgrevink.

April 25.—"Our Northern Rockies." Robert H. Chapman.

President Graham Bell has appointed the following committees of the Society:

Technical Meetings.—Richard U. Goode, G. W. Littlehales, Isaac Winston.

Annual Excursion.—Henry F. Blount, F. V. Coville, Raymond A. Pearson.

*Columbia Theater, 4.20 p. m.

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